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A new species of the *Elachista freyerella*-group (Elachistidae *s. str.*) from Japan

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Abstract *Elachista nipponicella* sp. nov. belonging to the *E. freyerella*-group is described on the basis of dozens of specimens collected at various localities in Japan. From other species of the same species-group known in the Far East, the new species can be separated by the characters of the phallus in the male and the shape of the ostium in the female. Some characters of the female genitalia show rather large individual variation, though such variation is continuous and considered to be individual variation within a single species. Biological notes are given for the new species.

Key words Bend of phallus, cornutus, ventral margin of ostium, spines on antrum, pupal morphology.

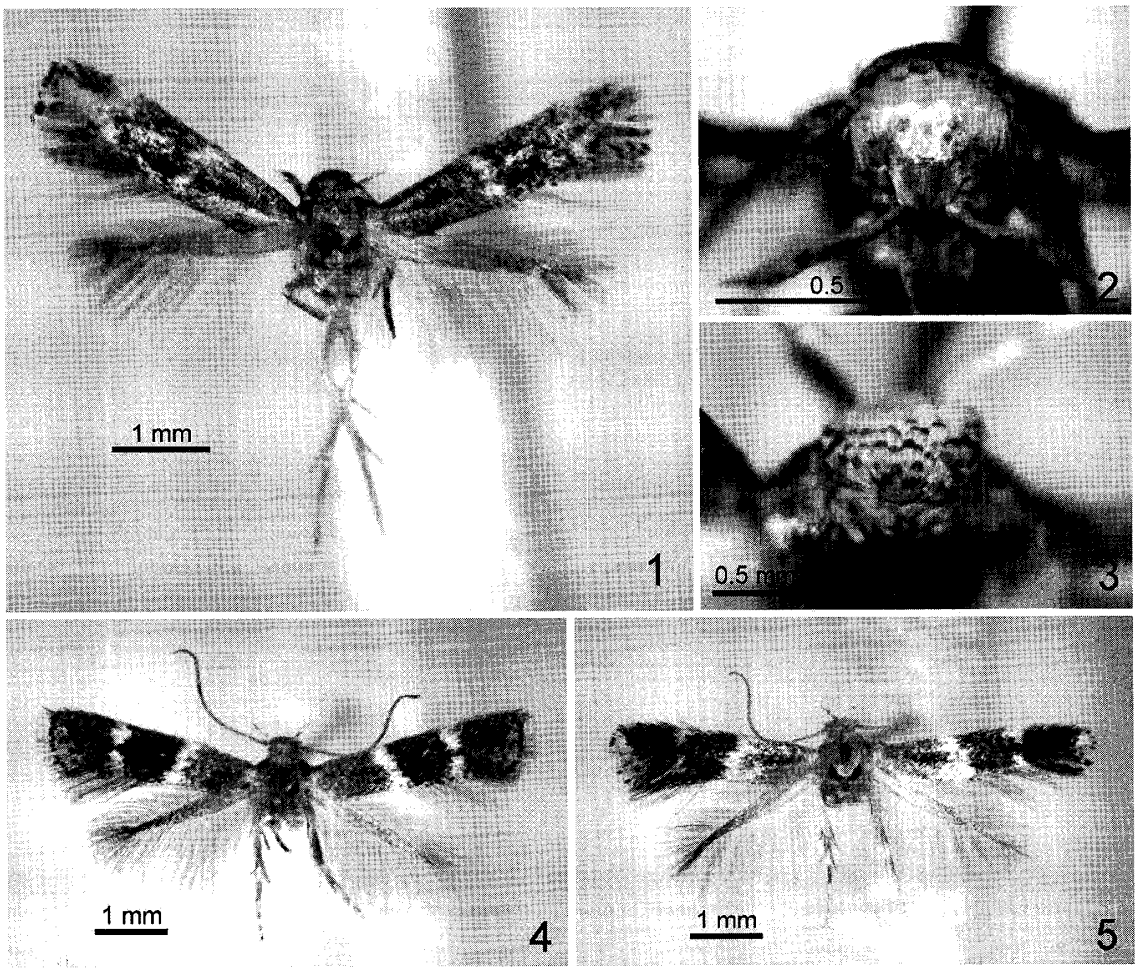
The *Elachista freyerella*-group was proposed by Kaila (1999*a*, *b*) as a monophyletic taxon in the subgenus *Elachista* on the basis of a phylogenetic analysis within the family Elachistidae in the strict sense. The species-group is best diagnosed by the male genital phallus (aedeagus in the traditional usage) that has a thin triangular lobe just near the cephalic end. In the female genitalia, the taxon is generally diagnosed by the character states of the antrum and colliculum: they are fused with each other and form an elongate sclerotized funnel, which extends cephalically into the sixth segment. Detailed diagnoses and phylogenetic position of the taxon are given in Kaila (1999*b*). In Japan, *Elachista japonica* (Parenti, 1983), *E. exactella* (Herrich-Schäffer, 1855) and *E. freyerella* (Hübner, 1825) have hitherto been reported (Parenti, 1983; Sinev & Sruoga, 1997; Oku, 2003). In the continent of the Russian Far East, three more species, *E. bifurcatella* (Sinev & Sruoga, 1995), *E. cornutifera* (Sruoga, 1995) and *E. pravella* (Sinev & Sruoga, 1995) have been recorded (Sinev & Sruoga, 1997).

In many institute and personal collections of micromoths in Japan, I found dozens of specimens belonging to the *Elachista freyerella*-group. Their male genitalia were fairly uniform except for the shape of the vinculum, which is likely to be one of the most variable characters within a species and thus least reliable traits in the *Elachista* (Kaila & Varalda, 2004), and suggested that they represent one species. On the other hand, their female genitalia showed considerable variation in some characters. In particular, the characters around the ostium varied to an extraordinary extent for a single species. Such variation, however, looked continuous because of intermediate specimens, and no effective criteria were detected for separating the female specimens into more than one group. I concluded that the specimens represent an undescribed species, and in the present paper, I describe the species as new.

The holotype is deposited in the National Science Museum, Sinzyuku-ku, Tôkyô, Japan (NSMT). Paratypes are in the following collections: NSMT, Entomological Laboratory, Osaka Prefecture University, Sakai, Ôsaka Pref., Japan (OPU), Systematic Entomology Laboratory, Hokkaido University, Sapporo, Hokkaidô, Japan (SEHU), Zoological Museum, Finnish Museum of Natural History, Helsinki, Finland (FMNH).

Elachista nipponicella Sugisima, **sp. nov.** (Figs 1–47)

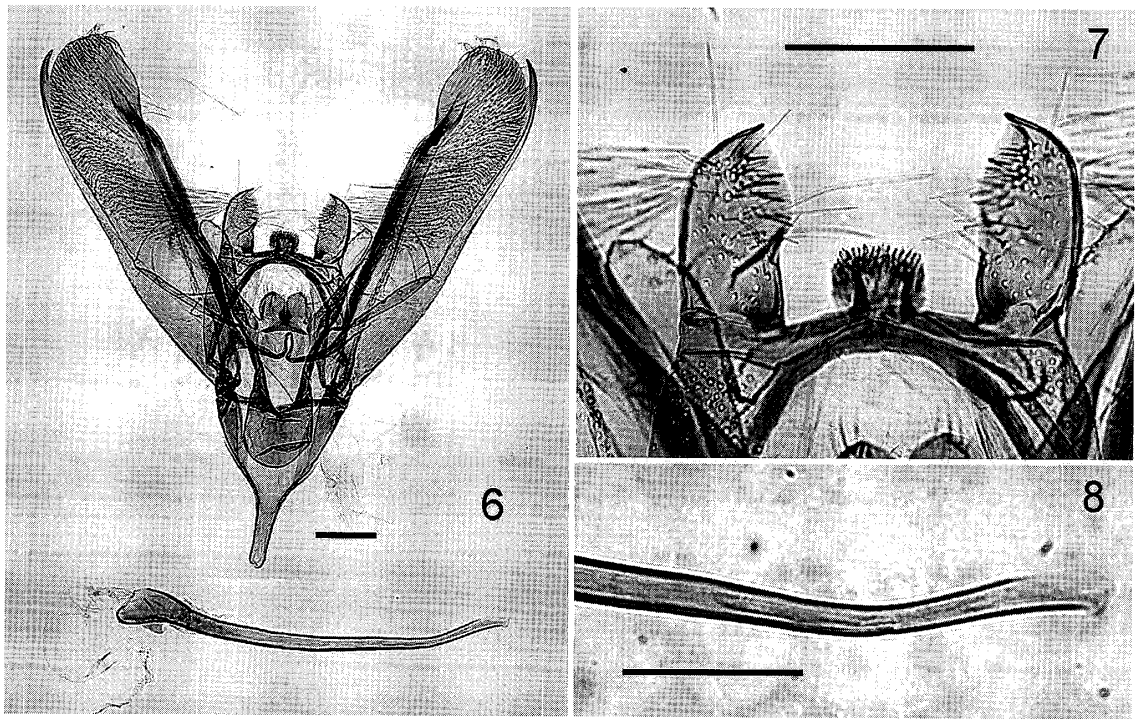
Specimens examined. Holotype. ♂, labelled "東京都皇居上道灌濠, Japan, Tokyo, Imperial Palace, Kami-Dokanbori, 25. V. 2000, Y. Arita [leg.]", "♂ genitalia, slide no. 1899, K. Sugisima, 2005", deposited in NSMT. Paratypes (names of collectors are omitted). Hokkaidô: 1 ♀, Tyûwa, Asahikawa, 6. VIII. 1998 (OPU); 5 ♂ 2 ♀, Isikari (Isikari-gawa-kakô, Isikari-hama, or Sinkô) (2 ♂ 1 ♀, 11. VII. 1995; 1 ♀, col. 13. VII. 1996 [larva], em. 24. VII. 1996, *ex Agropyron ciliare*; 3 ♂, 17–22. VI. 2003) (FMNH, NSMT, OPU, SEHU); 1 ♀, Bôyôdai, Otaru, 4. IX. 2001 (OPU); 8 ♂ 2 ♀, Sapporo (Kannon-zawa, Misumai, Moiwa, or Sapporo) (1 ♂, 3. V. 1956; 3 ♂, 10–11. V. 1962; 1 ♂, 4. VI. 1974; 3 ♂ 1 ♀, 24. V. 1991; 1 ♀, 7. VII. 1998 [1 ♂ 1 ♀ whole body dissected and mounted on slide]) (NSMT, OPU, SEHU); 2 ♂, Tokisatomappu, Tomakomai, 1. IX. 1984 (SEHU); 1 ♀, Horoman [misspelled "Horomitu"], Samani, col. 25. V. 1996 [larva], em. 10. VI. 1996, *ex Festuca parvigluma* (OPU); 1 ♂, Sunasaka, Esasi, 10. V. 1958 (SEHU); 1 ♀, Kikonai, 10. VII. 1976 (SEHU); Honsyû: 1 ♂, Hukiage-gyoen, Imperial Palace, Tôkyô, 16. IX. 2004 (NSMT); 1 ♂ 1 ♀, Ôkuti-zawa, Toyosina, Nagano Pref. (1 ♀, 14. VII. 1995; 1 ♂, 26. VIII. 1995) (OPU); 10 ♂ 4 ♀, Ueno, Azusagawa, Nagano Pref. (1 ♀, 13. VII. 1978; 1 ♂, 31. V. 1981; 2 ♀, 1–5.



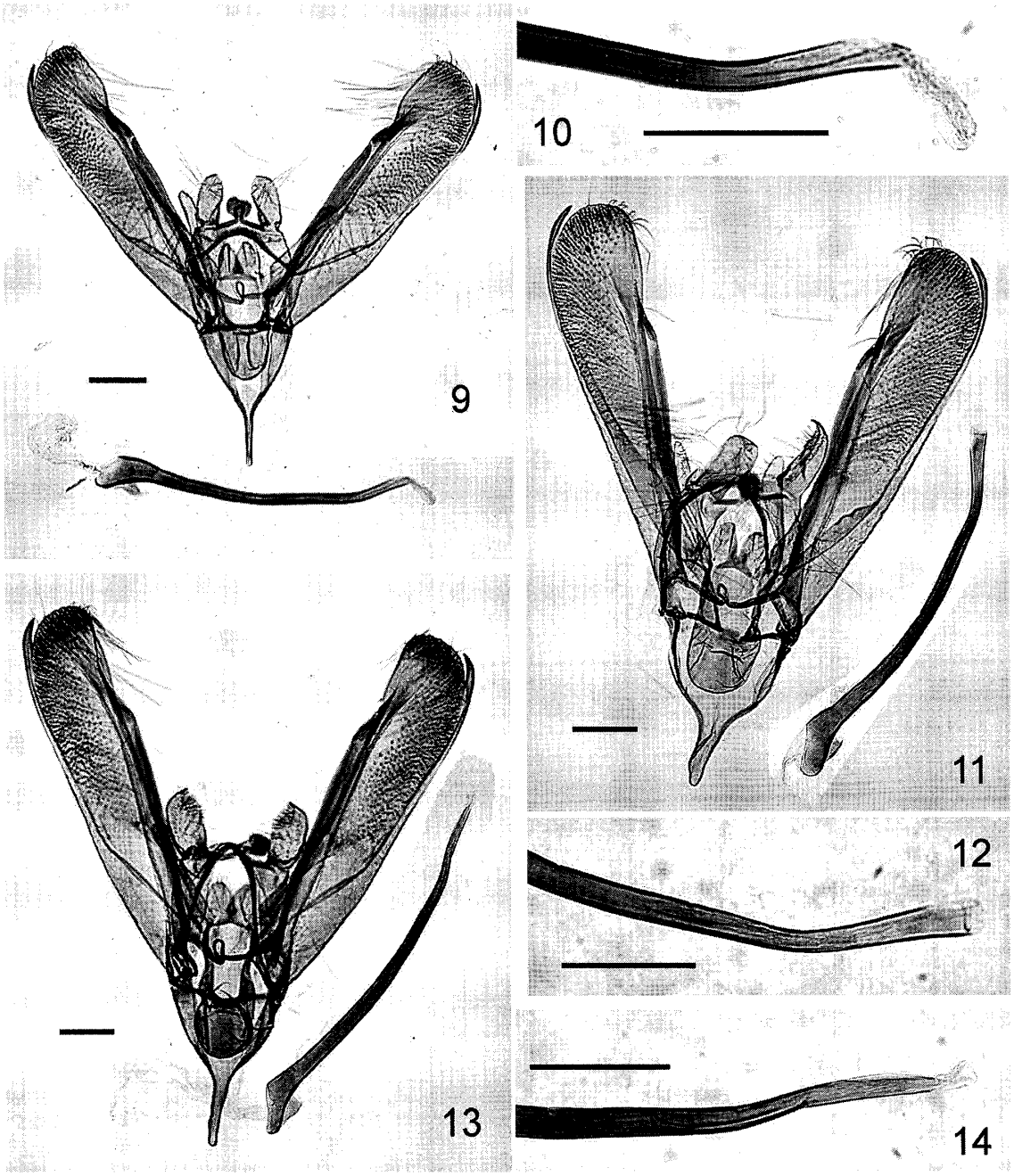
Figs 1–5. Moths of *Elachista nipponicella* sp. nov. 1–3. Holotype (1: whole moth, dorsal view; 2: face; 3: neck tufts and vertex). 4–5. Paratypes, female, Azusagawa, Nagano Pref. (4: 13. VII. 1978; 5: 1. VI. 1982).

VI. 1982; 1 ♂, 30. V. 1983; 1 ♀, 12. V. 1990; 8 ♂, 30. IV. 1999 [2 ♂ whole body dissected and preserved in glycerine]) (FMNH, NSMT, OPU, SEHU); 2 ♂, Kamanosawa, Azusagawa, Nagano Pref. (1 ♂, 21. VIII. 1977; 1 ♂, 31. VII. 1991) (OPU); 3 ♂, Azumi (Simasima-dani or Inekoki), Nagano Pref. (2 ♂, 15–24. VII. 1981, 1 ♂, 14. IX. 1986) (OPU); 1 ♂, Akamatu, Hata, Nagano Pref., 11. VI. 1986 (OPU); 1 ♂, Karasawa, Yamagata, Nagano Pref., 10. IX. 1979 (OPU); 1 ♀, Ontake-san-3-gôme, Ôtaki, Nagano Pref., col. 3. X. 1995 [larva], em. 19. X. 1995, *ex* Poaceae sp. (OPU); 1 ♀, Inabu, Aiti Pref., col. 2. X. 1995 [larva], em. 17. X. 1995, *ex Setaria viridis* (OPU); 1 ♂1 ♀, Nisimaiduru, Maiduru, [Kyôto Pref.], col. 26. III. 1996 [larva], em. 22–23. IV. 1996, *ex* Poaceae sp. (OPU); 1 ♀, Amami, [Kawatinagano], Ôsaka Pref., 16. V. 1979 (OPU); 1 ♀, Iwawaki-san, Ôsaka Pref., 19. V. 1965 (OPU); Kyûsyû: 1 ♂, Hukuoka, Hukuoka Pref., 7. VI. 1957 (SEHU); 1 ♀, Hiko-san, Hukuoka Pref., 3. V. 1957 (OPU); Tusima: 1 ♀, Asazi-yama, Mitusima, 27. III. 2002 (OPU).

Diagnosis. Head pale ochreous or rarely greyish, mottled with dark brown at least on vertex and neck tufts. Male forewing greyish or grey-brownish, mottled with paler colour, with whitish markings that are often indistinct: a transverse fascia on 1/3, two spots oppositely situated beyond 3/4, and a spot around apex of wing. Female forewing dark greyish or blackish, often mottled on basal 1/3, with whitish markings that are slightly more basal and more distinct than corresponding markings of male forewing. Male genitalia: uncus lobes twice as long as wide; valva about four times as long as wide; juxta lobe short and round; vinculum with distinct saccus that is as long as the remainder of the vinculum and somewhat varying in width; phallus almost as long as valva, distinctly bent around apical 1/5; vesica with a weak longitudinal sclerotized streak accompanied by minute weak spines. Female genitalia: ventral margin of ostium deeply U- or V-shaped; antrum-colliculum-complex funnel-shaped, widest around caudal 1/4, narrower near caudal end, longitu-

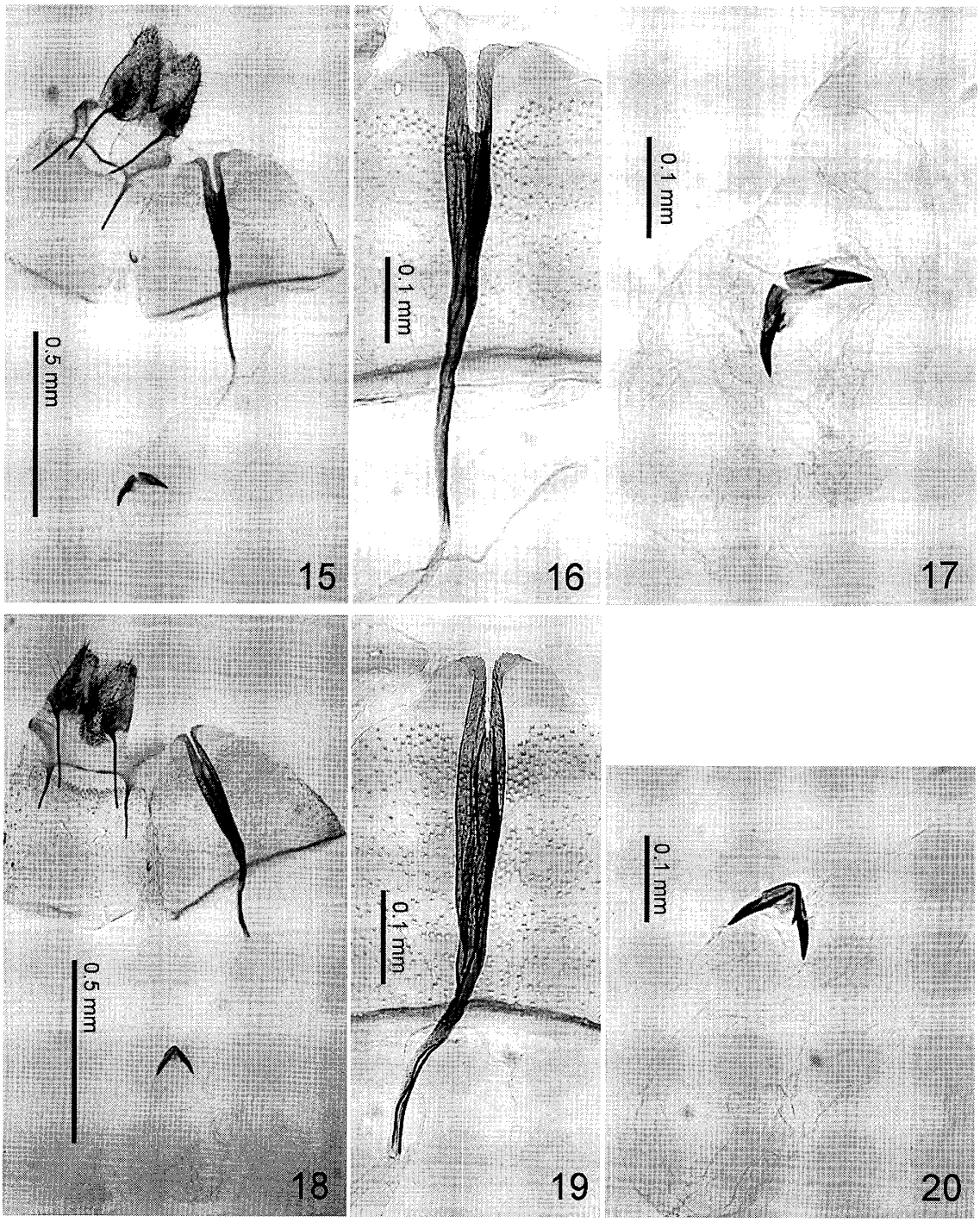


Figs 6–8. Male genitalia of *Elachista nipponicella* sp. nov., holotype, scales 0.1 mm. 6. Whole genitalia. 7. Uncus lobes. 8. Apical part of phallus, showing sclerotized streak of vesica.



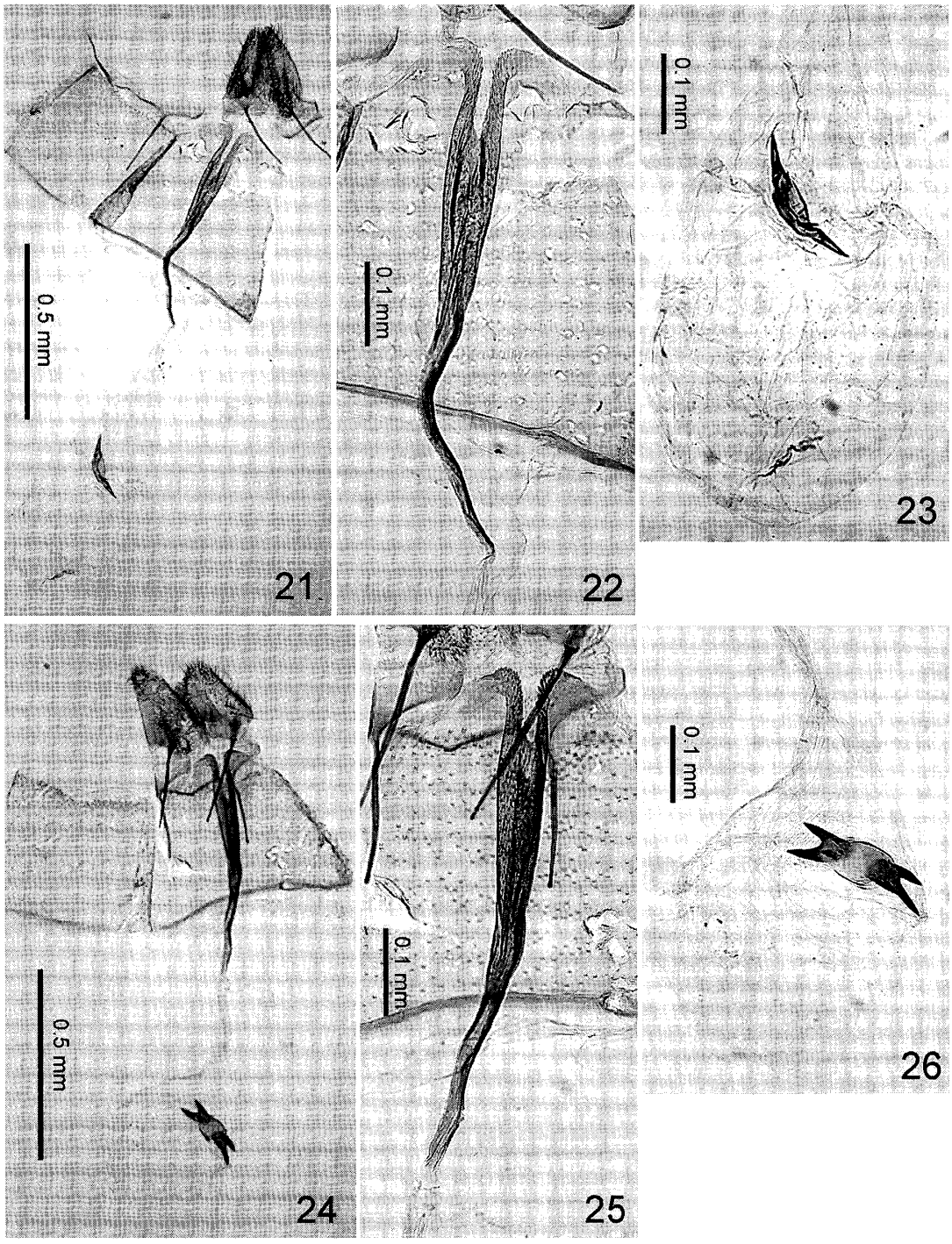
Figs 9–14. Male genitalia of *Elachista nipponicella* sp. nov., paratypes, scales 0.1 mm. 9. Same locality as the holotype (slide no. 1925), 16. IX. 2004, sclerotized streak of vesica magnified in Fig. 10. 11. Azusagawa, Nagano Pref., 30. IV. 1999 (slide no. 1791), sclerotized streak of vesica magnified in Fig. 12. 13. Azusagawa, Nagano Pref., 31. V. 1981 (slide no. 1489), sclerotized streak of vesica magnified in Fig. 14, apical part of aedeagus straightened artificially.

dinally folded, and lined with small sharp spines of various density; spined area of antrum-colliculum-complex ranging from near cephalic margin of seventh sternite to near caudal end, or in a few individuals, spines of high density extending to ventral margin of ostium; corpus bursae oval, with or without minute spines; signum with paired huge thorns or with one or two extra huge thorns.



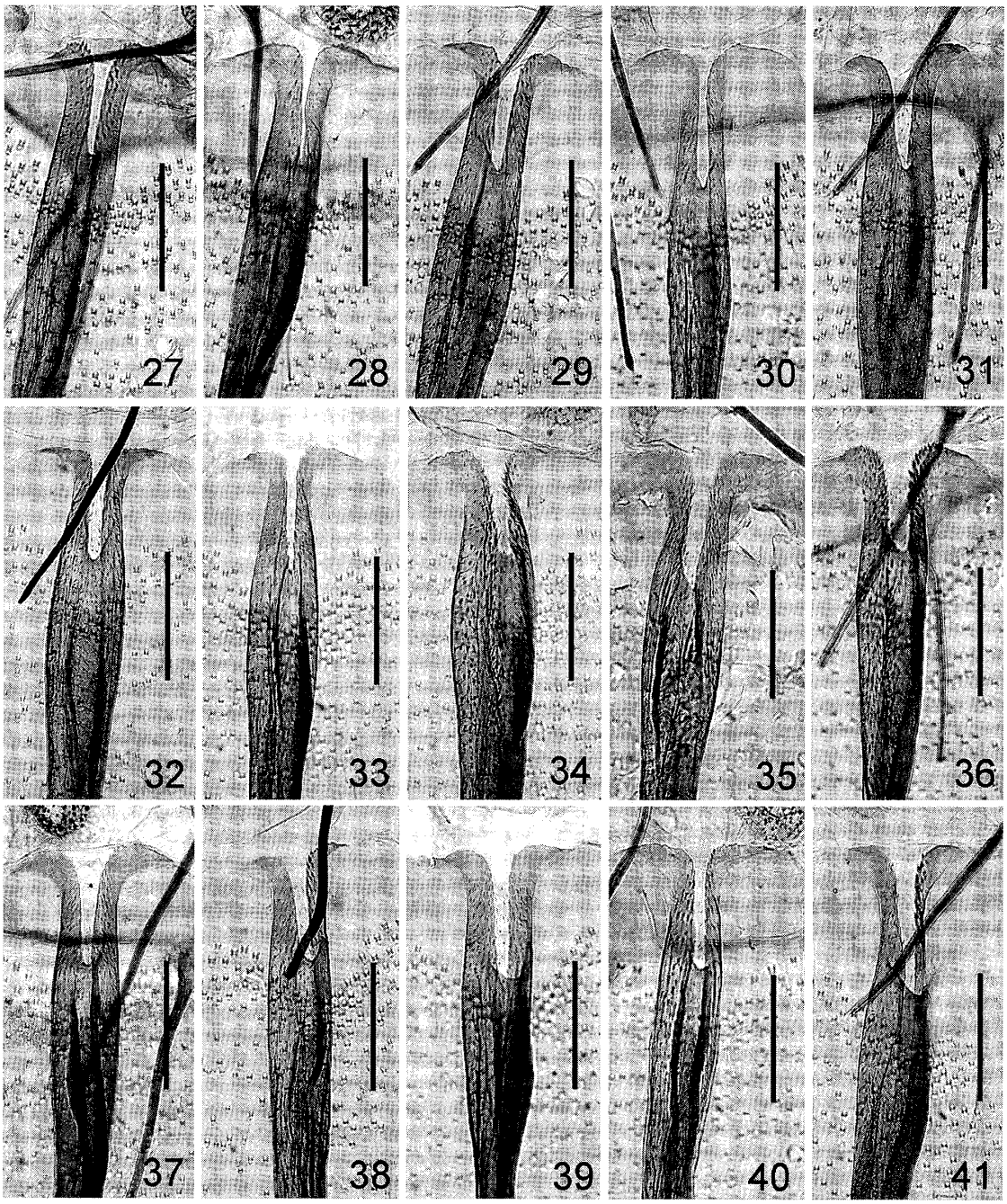
Figs 15–20. Female genitalia of *Elachista nipponicella* sp. nov., paratypes. 15. Maiduru, Kyôto Pref., antrum-colliculum-complex magnified in Fig. 16, corpus bursae magnified in Fig. 17. 18. Azusagawa, Nagano Pref., 13. VII. 1978, antrum-colliculum-complex magnified in Fig. 19, corpus bursae magnified in Fig. 20.

Description. Forewing length: ♂ 2.6–3.5 mm (holotype 2.9 mm); ♀ 2.8–3.6 mm; non-overwintering generation apparently smaller. Head generally pale ochreous, mottled with dark brownish tips of scales on vertex and neck tufts to a varying extent (Figs 2, 3); in some females, head pale greyish and mottled on frons as well as vertex and neck tufts. Outer sur-



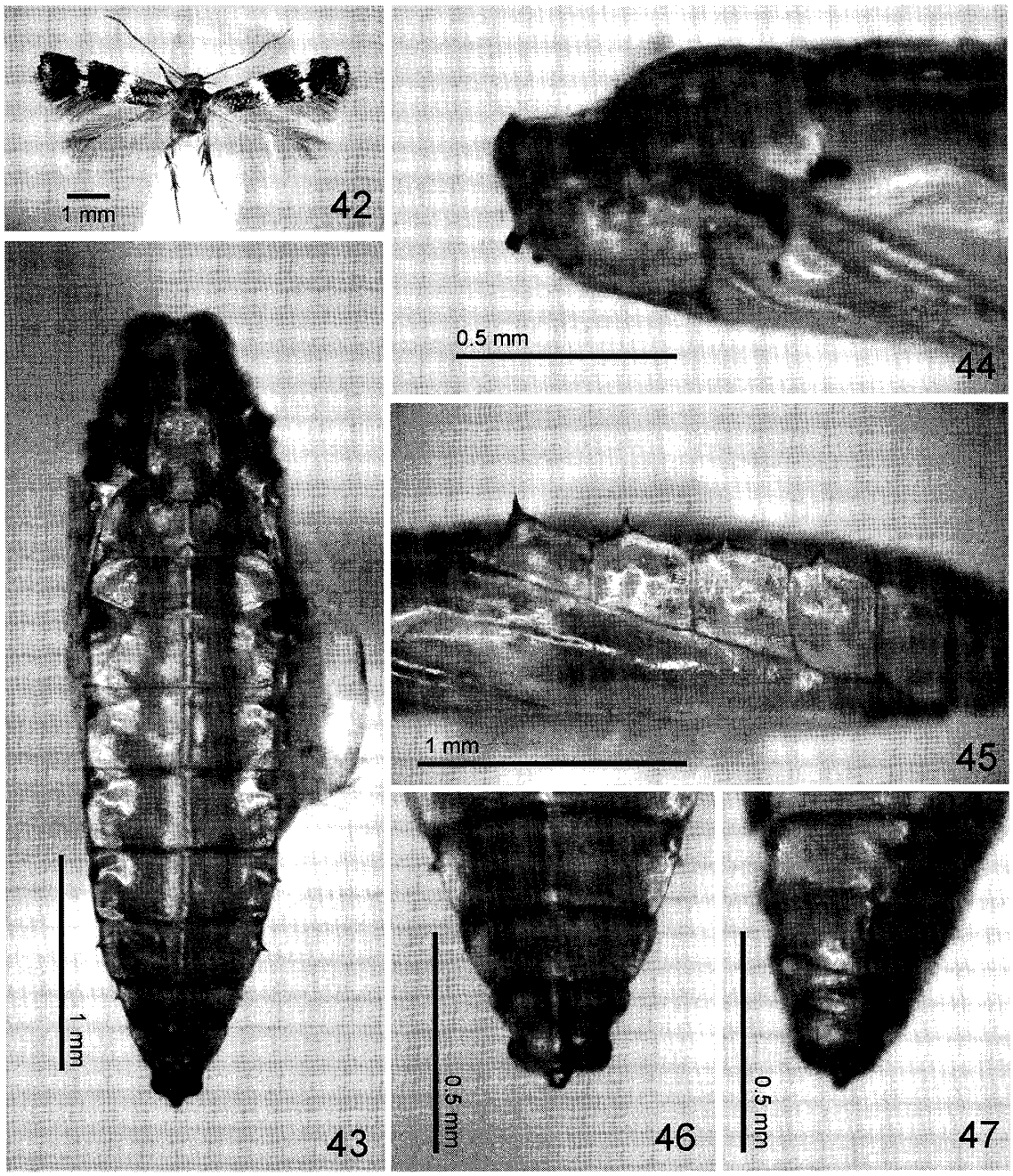
Figs 21–26. Female genitalia of *Elachista nipponicella* sp. nov., paratypes, Azusagawa, Nagano Pref. 21. 5. VI. 1982 (slide no. 1790), antrum-colliculum-complex magnified in Fig. 22, corpus bursae magnified in Fig. 23. 24. 1. VI. 1982 (slide no. 1813), antrum-colliculum-complex magnified in Fig. 25, corpus bursae magnified in Fig. 26.

face of labial palpi blackish, at apex of the second segment and around basal 1/4 of third segment pale ochreous. Thorax greyish, darker in female, weakly mottled with paler bases of scales. Male forewing (Fig. 1) greyish or grey-brownish, mottled with paler bases of scales; a whitish transverse fascia on 1/3, sometimes oblique, often blurred; two whitish



Figs 27–41. Antrum of female genitalia of *Elachista nipponicella* sp. nov., paratypes, scales 0.1 mm. 27. Asahikawa, Hokkaidô, slide no. 1798. 28–29. Isikari, Hokkaidô, slide nos 1446, 1479. 30. Otaru, Hokkaidô, slide no. 1817. 31. Sapporo, Hokkaidô, slide no. 1803. 32. Kikonai, Hokkaidô, slide no. 1805. 33–36. Azusagawa, Nagano Pref., slide nos 1499, 1495, 1790, 1813. 37. Ôtaki, Nagano Pref., slide no. 1439. 38. Inabu, Aiti Pref., slide no. 1519. 39. Maiduru, Kyôto Pref., slide no. 1450. 40. [Kawatinagano], Ôsaka Pref., slide no. 1794. 41. Tusima, slide no. 1492.

spots oppositely situated beyond 3/4 of wing, often very indistinct; a blackish mark on fold just outwards of whitish fascia, composed of raised scales; another blackish mark between two whitish spots beyond 3/4 of wing, sometimes forming a longitudinal streak; scales around and beyond apex of wing-disc whitish, often recognized as a conspicuous whitish



Figs 42–47. Moth and its pupal exuvia of *Elachista nipponicella* sp. nov., Maiduru, Kyôto Pref. 42. Moth. 43. Exuvia, dorsal view. 44. Exuvia, head, lateral view. 45. Exuvia, dorso-lateral ridge and spiracular cones, lateral view. 46. Exuvia, abdominal end, dorsal view. 47. Exuvia, abdominal end, lateral view).

spot; blackish fringe line present. Female forewing (Figs 4, 5, 42) dark greyish or blackish, little mottled entirely or mottled with paler scales only on basal 1/3; whitish markings generally as in male, while being much more conspicuous and situated slightly more basally than in male.

Male genitalia (Figs 6–14). Uncus lobes nearly twice as long as wide. Spinose knob of gnathos round, as long as wide or slightly longer than wide. Valva 3.9–4.4 times as long as

wide; apical thorn moderately developed for species of the *E. freyerella*-group, evenly curving and tapering towards apex; cucullus with dorsal margin almost straight or slightly angular, and with dorso-apical corner round. Digitate process slender, 1/3 as long as valva; apical part moderately swollen. Juxta lobe short and round for species of the *E. freyerella*-group. Vinculum rather variable in shape, with well-developed saccus, which is about the same length of the remainder of the vinculum. Phallus 0.92–1.05 length of valva, bent distinctly around apical 1/5; vesica with a longitudinal sclerotized streak, which is not sufficiently sclerotized as to constitute a genuine cornutus and accompanied by minute weak spines.

Female genitalia (Figs 15–41). Apophysis anterioris 0.8–1 length of apophysis posterioris. Ventral margin of ostium rather variable in shape (Figs 27–41), recognized as a fairly deep U- or V-shaped cleavage. Seventh sternite laterally and cephalically of ventral margin of ostium with a broadly naked and strongly sclerotized area, where a short seta may be present in each end of the ostium. Antrum-colliculum-complex funnel-shaped, longitudinally folded, widest around caudal 1/4 and usually narrower near caudal end; inner surface lined with small sharp spines of various density; spined area ranging from near cephalic margin of seventh sternite to near caudal end; in a few individuals (*e. g.* Figs 34, 36), spines of high density extending to ventral margin of ostium. Corpus bursae oval; inner surface usually smooth (Figs 17, 20), sometimes ornamented with sparse minute spines (Figs 23, 26); signum recognized as a round plate, which has usually a pair of oppositely directed huge thorns and a few smaller teeth (Figs 17, 20, 23) but rarely has extra huge thorns (Fig. 26).

Distribution. Japan: Hokkaidô, Honsyû, Kyûsyû, Tusima.

Biology. Foodplant: Poaceae: *Agropyron ciliare* (Trin.) Franch., *Festuca parvigluma* Steud., *Setaria viridis* P. Beauv., and a few unidentified grass species.

It is likely that *Elachista nipponicella* has more than one generation a year and hibernates as a pre-mature larva. The larva is a leaf-miner, and larval feeding was observed in the spring, summer, and autumn. The mine extends from near the tip of the leaf towards the base. It is generally full-depth, sometimes with the underside tissue partly left uneaten. The shape of the mine somewhat varies from elongate blotch-like to linear, possibly depending on the robustness of leaf-veins. Excrement is pushed into the older part of the mine behind the larva. The mature larva leaves the mine and pupates under a dense silk web. The pupa (Fig. 43) has characters typical for the *E. freyerella*-group: *i. e.* the vertex has a pair of spines (Fig. 44), and the abdomen has no mobility and its spiracles are situated on the top of conical projections (Fig. 45). The caudal margin of the mesothorax (Fig. 43) is medially flat rather than acute (or broadly U-shaped rather than V-shaped); the tenth segment has a short projection on the dorso-caudal end medially (Figs 46, 47).

Remarks. In the colouration of the scale vestiture and in the structures of the female genitalia, considerable variation was found among the specimens examined in this study. Particularly, the variation in the ostium and antrum (Figs 27–41) may be at an extraordinary level for a single species. Such variation, however, shows no effective criteria for dividing the present specimens into more than one species. Although the character states of individuals of Fig. 28 and Fig. 36 are quite different, there are many specimens with intermediate states and thus the two individuals appear to represent extreme ends of a continuous variation. In addition, there was no significant variation in the male genitalia and in the pupal morphology. Therefore, I here conclude that all the present specimens belong to a single species, *Elachista nipponicella*, which shows a considerable variation in the colouration and in the female genitalia.

Apart from *E. nipponicella*, six species of the *E. freyerella*-group are known in the Far East including Japan: *E. bifurcatella* (Sinev & Sruoga, 1995), *E. cornutifera* (Sruoga, 1995), *E. exactella* (Herrich-Schäffer, 1855), *E. freyerella* (Hübner, 1825), *E. japonica* (Parenti, 1983) and *E. prasella* (Sinev & Sruoga, 1995). The female is known only for *E. exactella* and *E. freyerella*, while the male is known for all these six species. Because of the variation in the colouration, *E. nipponicella* can be confused with all the six species in the external appearance.

In the male genitalia, *E. nipponicella* can be distinguished from the other six species by the character states of the phallus. The phallus is distinctly bent around apical 1/5 in *E. nipponicella*, while the phallus is smoothly curving from the base to the apex in *E. freyerella* and *E. japonica*. Additionally, the vesica of *E. japonica* has a small but distinct cornutus, which is not recognized in *E. nipponicella*. In *E. exactella* and *E. cornutifera*, the phallus has a distinct bend around apical 1/5 as in *E. nipponicella*. The phallus of *E. nipponicella* is smoothly curving except for the bend around apical 1/5, while that of *E. exactella* has another distinct bend around the middle. Moreover, the uncus lobe and the juxta lobe of *E. exactella* are narrower than those of *E. nipponicella*. The vesica of *E. cornutifera* has a distinct needle-like cornutus, which is absent in *E. nipponicella*. In *E. prasella*, the phallus is distinctly bent around the middle, where it is smoothly curving in *E. nipponicella*. In addition, a spine is recognized on the digitate process in *E. prasella*, while such a spine is absent in *E. nipponicella*. The phallus of *E. bifurcatella* is bifurcate in the apical half, whereas that of *E. nipponicella* is simply tubular.

In the female genitalia, *E. nipponicella* can be separated from *E. exactella* and *E. freyerella* by the characters of the ostium. The ventral margin of the ostium is deeply U- or V-shaped in *E. nipponicella*, shallowly V-shaped in *E. exactella*, and recognized as a parabola-shaped concavity in *E. freyerella*. Moreover, the antrum of *E. exactella* is broader than that of *E. nipponicella*.

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摘　　要

Elachista freyerella 種群の日本からの1新種 (クサモグリガ科) (杉島一広)

Elachista nipponicella Sugisima, sp. nov. (Figs 1–47) ニッポンクサモグリガ (新称)

前翅長♂ 2.6–3.5 mm, ♀ 2.8–3.6 mm で, 非越冬世代は一回り小型らしい. 頭部 (Figs 2, 3) は淡黄褐色, 稀に灰色; 後頭部は鱗片先端が暗褐色なせいでまだら状. ♂の前翅 (Fig. 1) は灰色か灰褐色で, 1/3 に白色横帯, 3/4 強の前縁と後縁に向かい合った白色紋, 翅頂付近に白色小斑が現れる (白色の模様はときに不明瞭); 横帯のすぐ外側の折り目沿いに逆立った黒色鱗片塊; 3/4 強の紋の間に黒色の縞. ♀の前翅 (Figs 4, 5, 42) は暗灰色から黒色で, ♂の場合よりやや基部寄りに明瞭な白色の模様を持つ; 1/3 の横帯より基部側が淡色なこともある. ♂交尾器 (Figs 6–14): uncus lobe は長さが幅の2倍; valva (把握器) は長さが幅の約4倍; juxta lobe は幅広で丸味を帯びる; phallus (挿入器) は valva とほぼ同長で, 先端から 1/5 近辺で明瞭に屈曲し, それ以外の部分は緩やかに湾曲する; vesica には微小棘群に囲まれた縦方向の硬化縞があるが, 硬化の程度は軽微で cornutus と呼べるほどではない. ♀交尾器 (Figs 15–41): ostium (交尾口) 覆面側の縁は深いU字ないしV字形に切れ込む; antrum-colliculum-complex は後方から 1/4 周辺で最も幅広く, 後端近辺ではやや細まる; ostium 腹面側の縁の形状や antrum 内面の棘の範囲と密度は個体差が激しい. 極東から知られる近似種からは, ♂では cornutus の有無を含めた phallus の形状によって, ♀では ostium 腹面側の縁の切れ込みの形状によって識別される. 年2世代以上で, 中期幼虫越冬らしい. 寄主植物はイネ科のアオカモジグサ, ウシノケグサ, エノコログサおよび未同定のイネ科数種. 蛹 (Figs 43–47) の特徴は *E. freyerella* 種群に典型的. ♀交尾器の特徴にはかなり大きな変異が観察された. しかし, そうした変異が連続的であることと, ♂交尾器や蛹形態には変異が見られないことから, 今回検討した標本は個体変異の激しい単一種を表すと判断した.

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